

## PALMESTON NORTH GOLF COURSE STOPBANKING AND PONDING AREA

### PURPOSE

To report on the storage volume in the Palmerston North Golf Course and the height of the old stopbank required to prevent flooding of adjacent residential areas.

### CONCLUSION

The Palmerston North Golf Course ponding area will contain the worst-case runoff from the urban catchment from a 100 year 3 day storm event and the seepage from the toe drains installed next to the new stopbank, even if the old stopbank was removed down to ground level.

### BACKGROUND

**horizons.mw** committed to providing a report on this subject to the landowners adjoining the old Golf Course Stopbank at a meeting on 26 June 2000. This investigation was carried out on request from Brent Cowie, Director of Resources at **horizons.mw**.

### DISCUSSION

The stopbank around the north and west of the Palmerston North Golf Course stopbank was initially constructed prior to the inception of the Lower Manawatu Scheme (LMS). It was upgraded in the early 1960's as part of the LMS construction works and was designed to contain a 100 year flood with 900 mm of freeboard.

The stopbank was upgraded in the early 1990s following investigations that showed it was not up to the Schemes design standard at that time.

Subsequent to this, a new stopbank has been constructed between the Golf Course and the Manawatu River following the recommendation of the LMS Review. The old stopbank is now no longer required as the first line of defence to prevent flooding of Palmerston North City.

**horizons.mw**'s Senior Design Engineer, Graham Doull, who carried out the design of the new stopbanks and the analysis of the risk of a failure of the cities stopbank system, believes that the stopbank should remain as a second line of defence. My analysis and conclusion from this investigation does not imply that the stopbank should be removed or be allowed to be removed by the adjacent landowners.

The only outlet for stormwater ponding in the Golf Course is via the large culvert beneath the stopbank at the Ruahine street end of the Golf Course. In the event of a large flood in the Manawatu River the floodgate that prevents water flooding back into the Golf Course closes and until the river level drops below the level of the water ponding in the Golf Course, all stormwater ponds in the Golf Course.

## **ANALYSIS**

### **Ground level information**

From a survey carried out of the Palmerston North City Stopbanks in 1989, the ground level on the inside of the stopbank was identified. The ground level at the north-eastern corner of Ruamahanga Crescent is at RL 36.03. The ground slopes fairly uniformly around to the downstream end of the Golf course to RL 33.66. The lowest part however is slightly upstream of this point at 477 Ruahine Street where the ground level is at RL 32.93. A section of high ground exists directly downstream of Brightwater Terrace but the land in behind this area is low.

### **Golf Course Ground Levels Information**

The levels in the Golf Course were obtained from a set of 1 to 2500 contoured aerial photographs flown on 1991. These are located in **horizons.mw**'s plan archive, No. 2913. Cross sections were determined from these aerial photographs. The information is set out in Annex A. It was assumed that the stopbanks at each end of the cross section had a height of RL 33.00. In all cases the actual stopbank level was higher than this, but making this assumption simplified the calculations.

### **Storage Volume Calculations**

The storage volume was calculated by determining the area of each cross section below RL 33.00. This level was chosen because with the exception of the area described above all the adjacent residential land is above that level. Storage volumes were calculated using the end area technique. Where the cross sections were not parallel the average distance between them was used. This will give a conservative estimate of storage volume.

The volume of the golf course ponding area below RL 33.00 is 356,600 cubic metres. The storage volume calculation is set out in Annex B.

### **Urban Runoff Calculation**

Information on the catchment area was obtained from Fin Mason at Palmerston North City Council along with runoff information set out in the Palmerston North City Council Stormwater Design Manual.

A worst case Scenario of a 100 year rainstorm over a 72 hour period gave a runoff volume of 104,500 cubic metres. This is less than 1/3 of the available ponding storage. The runoff volume calculations are set out in Annex C.

### **Stopbank toe drain seepage**

horizons.mw Senior Design Engineer Graham Doull as stated that the expected flow from the toe drains during a design flood would do little more than fill the main drain along the edge of the Golf Course. My very conservative estimate of the volume of this water is say 25,000 cubic metres.

## Water Arising from the Golf Course Itself

Treating the Golf Course as a park within the rules of the PNCC Design Manual the total volume of rain falling on the Golf Course that adds to the ponded water would be about 20,000 cubic metres. The runoff volume calculations are set out in Annex C.

### SUMMARY

<b>Runoff from</b>	<b>Total Volume (cubic metres)</b>
Urban area	105,100
Golf Course	20,000
Toe drains	25,000
<b>TOTAL</b>	<b>150,100</b>
Total Storage available below RL 33.00	<b>356,600</b>
<b>PROPORTION OF STORAGE TAKEN UP</b>	<b>42%</b>

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## Cross sections of Palmerston North Golf Course ponding area

Cross sectional area below RL= 33.00 metres

xsect 1			xsect 2			xsect 3		
Distance	level	area	Distance	level	area	Distance	level	area
0	33		0	33		0	33	
50	33	0	25	32	12.5	50	32	25
110	33	0	35	32	10	100	32	50
215	33	0	60	31	37.5	180	32	80
245	33	0	70	31	20	290	33	55
250	33	0	180	32	165	295	33	0
			270	33	45			
			275	33	0			
		0			290			210

xsect 4			xsect 5			x sect 6		
Distance	level	area	Distance	level	area	Distance	level	area
0	33		0	33		0	33	
140	32	70	35	30	52.5	15	30	22.5
185	32	45	75	31	100	45	30	90
230	33	22.5	95	32	30	51	31	15
265	33	0	165	33	35	80	32	43.5
295	33	0	195	33	0	110	32	30
315	33	0	270	33	0	180	33	35
			320	33	0	230	33	0
			325	33	0	350	33	0
		137.5			217.5	370	33	0
								236

xsect 6A			xsect 7			xsect 8		
Distance	level	area	Distance	level	area	Distance	level	area
0	33		0	33		0	33	
15	30	22.5	20	30	30	40	32.7	6
50	30	105	40	30	60	45	30	8.25
68	31	45	71	31	77.5	67	29	77
115	32	70.5	100	32	43.5	70	30	75
250	33	67.5	200	32	100	100	31	75
385	33	0	390	32.5	142.5	155	32	82.5
400	33	0	420	33	7.5	200	32	45
			425	33	0	330	32	130
						450	33	60
						455	33	0
		310.5			461			558.75

x sect 9			xsect 10			xsect 11		
Distance	level	area	Distance	level	area	Distance	level	area
0	33		0	33		0	33	
35	30	52.5	40	30	60	43	30	64.5
49	29	49	50	29	35	48	29	17.5
62	30	81	60	30	60	52	30	27
90	31	70	90	31	75	78	31	65
150	32	90	170	32	120	200	31.9	189.1
220	32	70	280	32	110	255	32	57.75
260	32	40	300	32	20	260	33	2.5
290	32	30	410	33	55			
420	33	65	415	33	0			
425	33	0						
		547.5			535			423.35

xsect 12		
Distance	level	area
0	33	
15	33	0
30	32	7.5
55	31	37.5
65	32	15
70	33	2.5
		62.5

### Storage volume in Palmerston North Golf Course ponding area

x section number	area square m	distance apart m	storage volume below RL= 33 cubic m
1	0		
2	290	100	14500
3	210	100	25000
4	138	100	17375
5	218	100	17750
6	236	100	22675
6A	311	100	27325
7	461	100	38575
8	559	60	30593
9	548	100	55313
10	535	65	35181
11	423	80	38334
12	63	140	34010
<b>TOTAL STORAGE VOLUME</b>			<b>356630 cubic metres</b>

A 100 year flood in the River would keep the gate closed for about 2 days with water at the top of the drain.

At a worst case scenario the golf course would be full and the gate would open sooner.

**Note** the calculation carried out here to determine volume is crude but produces results that underestimate the available volume, not over estimates it.

## Urban Runoff to Palmerston North Golf Course ponding area

From PNCC Stormwater design manual

100 year 72 hr rainfall	161.7 mm
Total catchment area	78 ha
say 25% pervious	19.5 ha
say 75% impervious	58.5
runoff factor pervious	0.32
runoff factor impervious	1
RUNOFF =	104,685 CUBIC METRES